II. REJECTION OF CLAIMS 1-20 UNDER 35 U.S.C. § 103(a)

Claims 1-20 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,270,265 (Hemmenway et al.) in view of U.S. Patent No. 6,159,844 (Bothra). Reconsideration and withdrawal of this rejection is respectfully requested for at least the following reasons.

i. Neither Hemmenway et al. nor Bothra teach plasma etching to strip the sacrificial material and the hard mask in a single etch process as recited in claim 1.

Claim 1 is directed to a method of stripping a hard mask from a substrate. The method comprises coating the substrate with a sacrificial material that fills gaps in a hard mask, and ***plasma etching to strip the sacrificial material and the hard mask in a single plasma etch process***. Hemmenway et al. not only do not teach the above feature, but require the removal of materials be performed ***in a multi-step process***. As averred in the Office Action, the photoresist or buffer material 51 and the hard mask 11 of Hemmenway et al. are interpreted as the recited sacrificial layer and hard mask, respectively. In discussing removal of the buffer material 51 and the hard mask 11, a two-step removal process is employed (*see, e.g.*, Col. 3, ln. 46 - Col. 4, ln. 26). More particularly, ***Hemmenway et al. require a multi-step removal process by requiring the buffer material be selective with respect to the hard mask***. For example, the reference states:

> In the foregoing example, the only limitation on the choice of buffer material 51 is that it be selective with respect to the materials that are used for the 'hard' mask layer 11 and the buried layer 21.... (Col. 4, lns. 5-8).

Therefore not only does Hemmenway et al. not teach a single step plasma etch to strip sacrificial material and the hard mask, ***the cited reference prohibits a single step solution by requiring etch selectivity between the two materials***. Therefore the art does not teach the claim feature, and one of ordinary skill in the art (upon evaluating

Hemmenway et al. as a whole) would not be motivated to modify the art in accordance with the present invention because doing so would contravene the teaching therein. Therefore claim 1 and its associated depending claims are non-obvious over the cited art. Accordingly, withdrawal of the rejection is respectfully requested.

ii. Even if the cited art could be combined properly, Bothra does not teach plasma etching of a hard mask as recited in claim 1.

The Office Action concedes that Hemmenway et al. has deficiencies, but asserts that Bothra remedies such deficiencies. More particularly, the Office Action avers that Bothra discloses a plasma etching of a hard mask layer using CHF_3/O_2 (*see* O.A., 4/2/03, p. 3, last paragraph). ***Bothra, however, does not utilize the silicon nitride layer 209 cited in the Office Action as a hard mask. Rather, the layer 209 is employed as an etch stop layer for the etching of an overlying dielectric layer***, as clearly seen in Fig. 5 and in the accompanying text. As seen therein, a photoresist layer 218 is employed as an etch mask to pattern the dielectric material 216, wherein the etch stops on the silicon nitride layer 209 (hence layer 209 is an etch stop). Then, as clearly seen in Fig. 6 and discussed in the accompanying text, the silicon nitride layer 209 is etched; during such etch, the photoresist mask 218 is maintained and thus the etch is selective with respect to the photoresist. Thus the photoresist mask 218 may be considered as a hard mask, not the silicon nitride layer 209. Therefore one of ordinary skill in the art, upon evaluating the teaching of Bothra as a whole, would not be motivated to combine the teachings thereof to employ the etch chemistry discussed therein for the silicon nitride etch stop layer 209 in conjunction with Hemmenway et al. which is directed to removal of the hard mask.

Further, even if such a combination were proper, such teachings would not provide the present invention since in both cases, the etch processes taught therein are directed to multi-step removal processes in direct contravention with applicants' claim language. Therefore for this additional reason, the claims at issue are non-obvious over the cited references.

iii. Hemmenway does not teach plasma etching sacrificial material completely from the gaps, as recited in claim 8.

Claim 8 recites plasma etching sacrificial material completely from the gaps, which is not taught or suggested by Hemmenway. As taught in the reference, Hemmenway uses a photoresist wash to remove remaining unexposed photoresist 65 to obtain the trench-patterned structure as shown in FIG. 8 (*see, e.g.*, Col. 3, ln. 68 - Col. 4, ln. 4). Consequently, Hemmenway does not teach plasma etching sacrificial material completely from the gaps nor does Bothra cure this deficiency. Thus for this additional reason, claim 8 is non-obvious over the cited art and withdrawal of the rejection is respectfully requested.

III. REJECTION OF CLAIMS 21-26 UNDER 35 U.S.C. § 103(a)

Claims 21-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hemmenway et al. in view of Bothra and U.S. Patent Publication No. 2002/0117706 (Shimizu). Reconsideration and withdrawal of the rejection is respectfully requested for at least the following reasons.

i. Hemmenway et al. do not teach removing the sacrificial layer and the hard mask layer with a dry etch, wherein the etch rates thereof are about the same, as recited in claim 21, and the secondary references do not remedy the deficiency thereof.

Claim 21 is directed to a method of removing a hard mask. A hard mask is formed and patterned. A sacrificial layer is then formed over the patterned hard mask layer, wherein the sacrificial layer material covers the hard mask and fills in the gaps. The sacrificial layer and hard mask layer are then removed with a dry etch, wherein an etch rate of the sacrificial layer and the hard mask layer are about the same. The cited references do not teach this feature.

As highlighted above, Hemmenway et al. do not teach an etch rate of the sacrificial layer and the hard mask layer being the same. In fact, the cited reference

teaches the opposite, wherein the sacrificial layer material is intentionally selected to be selective with respect to the material employed as a hard mask (*see, e.g.*, Col. 4, lns. 5-8). Therefore Hemmenway et al. do not teach the above claim feature.

In addition, the Office Action asserts that Shimizu teaches a removal of the sacrificial layer and hard mask layer using a single etch process, citing to p. 5, paragraph 0081 therein. It is respectfully submitted that the portion of the reference cited in the Office Action does not teach the above feature as claimed. Rather the paragraph at issues states:

> [0081] After application of a photoresist 19 on silicon nitride film 18 by photolithography, photoresist 19 is patterned into a predetermined shape. Using this photoresist 19 as a mask, as shown in FIG. 3, silicon nitride film 18, doped polysilicon film 6 and thermal oxide film 4 are dry-etched.

If the photoresist 19 is considered to be the sacrificial layer and the silicon nitride film 18 is the hard mask, clearly the reference does not remove them both in a single step dry etch process as claimed. In addition, nothing in the cited reference suggests that the polysilicon film 6 or the thermal oxide film constitute either a hard mask layer or a sacrificial layer as claimed. Therefore the teaching of Shimizu does not result in the invention of claim 21. Thus claim 21 and its associated depending claims are non-obvious over the cited art.

Even if Shimizu did teach the feature at issue, it is respectfully submitted that in such an instance, a combination of Shimizu with Hemmenway et al. would be improper. References may be combined or modified when one of ordinary skill in the art would be motivated to make such a combination or modification. Such motivation, however, must be clear and particular, In re Dembiczack, 175 F.3d 994, 999 (Fed. Cir. 1999). Further, such motivation does not exist in circumstances where a combination or modification would frustrate an intended purpose of a reference. MPEP § 2143.01 (stating "[i]f a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification."). ***Since Hemmenway et al. clearly indicate that***

the removal of the sacrificial layer and the hard mask layer should be completed separately (as evidenced by the requirement that the etch selectivities be different), then one of ordinary skill in the art would not be motivated to combine Shimizu with Hemmenway et al. because such a combination would alter this requirement and make Hemmenway et al. unsatisfactory for its intended purpose. Therefore a combination of the references is improper, and for this additional reason the claims are non-obvious over the cited art. Accordingly, withdrawal of the rejection is respectfully requested.

ii. The Office Action mischaracterizes Hemmenway et al. in stating that the reference does not explicitly disclose the etch rate of the sacrificial layer and hard mask layer, respectively.

In rejecting claims 21-26, the Office Action states the following:

> Hemmenway fails to explicitly disclose the etch rate of the sacrificial, hard mask, and silicon layers as recited in present claims 21 and 24.
>
> However, there is no evidence indicating that the etch rate of the sacrificial, hard mask, and silicon layers are critical and it has been held that it is not inventive to discover the optimum or workable rate of a result-effective variable within given prior art conditions by routine experimentation. See MPEP 2144.05. (*see* O.A., 4/2/03, p. 5, ¶¶ 4-5).

The above characterization of the Hemmenway et al. reference is incorrect because it indicates that one of ordinary skill in the art would not appreciate that the etch rates associated with various layers are relevant. In fact, as stated *supra*, the cited reference clearly states that whatever the etch rates are, the materials associated with the sacrificial layer and the hard mask layer are selected such that they are selective with respect to one another. ***That is, regardless of the etch rate values, the etch rates should differ from one another significantly, and this would be clearly appreciated from one of ordinary skill in the art.***

In addition, the above-cited portion of the Office Action indicates that no evidence exists that the etch rates of the various layers are critical. Applicants'

specification, however, clearly discusses the etch rates and the advantages associated therewith. For example, on page 5, lns. 26-30, some exemplary etch rates are provided, and on page 8, lns. 5-19, exemplary advantages associated with this claim feature are discussed. Thus the above feature should be accorded patentable weight, and when done so in a proper manner, the cited art clearly do not teach the present invention. Accordingly, for at least this additional reason, withdrawal of the rejection is respectfully requested.

iii. The cited references do not teach or suggest a removal of the sacrificial layer and hard mask layer with a single etch process, wherein the etch rate of the hard mask layer is substantially greater than the silicon layer, as recited in claim 24.

Claim 24 is directed to a method of removing a hard mask, wherein the hard mask is formed over a silicon layer. The hard mask is patterned and a sacrificial layer is then formed over the patterned hard mask layer. The sacrificial layer material covers the hard mask and fills in the gaps. The sacrificial layer and hard mask layer are then removed with a dry etch, wherein an etch rate of the hard mask layer is substantially greater than the underlying silicon layer. The cited references do not teach this claim feature. Instead, the Office Action ignores the above claim feature, as highlighted above.

As stated in applicants' specification, for example, on page 6 (and illustrated in Figs. 4-6), having selectivity to an underlying silicon material allows the hard mask layer to be completely removed without substantial removal to the underlying layer, and such advantages would be appreciated by those skilled in the art. Therefore the above limitation should be accorded patentable weight. Further such feature is not taught by the cited art and thus claim 24 and its associated depending claims are non-obvious over the cited references. Accordingly, withdrawal of the rejection is respectfully requested.

IV. CONCLUSION

For at least the above reasons, the claims currently under consideration are believed to be in condition for allowance.

Should the Examiner feel that a telephone interview would be helpful to facilitate favorable prosecution of the above-identified application, the Examiner is invited to contact the undersigned at the telephone number provided below.

Should any fees be due as a result of the filing of this response, the Commissioner is hereby authorized to charge the Deposit Account Number 50-1733, AMDP714US.

Respectfully submitted,
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CERTIFICATE OF MAILING (37 CFR 1.8a)

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Box Non-Fee Amendment, Assistant Commissioner for Patents, Washington, D.C. 20231.

Date: April 9, 2003 Christine Gillroy
Christine Gillroy

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APPENDIX CONTAINING AMENDMENTS IN MARKED UP FORMAT

IN THE CLAIMS:

Please amend claims 1 and 24 as follows below:

1. (Amended) A method of striping a hard mask from a substrate comprising an insulating material exposed within gaps patterned through the hard mask, comprising:

coating the substrate with a sacrificial material that fills the gaps; and

plasma etching to strip the sacrificial material and the hard mask in a single plasma etch process.

24. (Amended) A method of removing a hard mask comprising:

forming an oxide region over or within a semiconductor substrate;

forming a silicon layer over the semiconductor substrate, wherein the [poly]silicon layer covers the oxide region;

forming and patterning a hard mask layer over the [poly]silicon layer;

etching a gap in the silicon layer to expose a portion of the oxide region using the patterned hard mask as an etch mask;

forming a sacrificial layer having a relatively planar top surface over the semiconductor substrate, the sacrificial layer comprising a portion covering the hard mask layer and a portion filling the gap; and

removing the sacrificial layer and the hard mask layer with a single etch process, wherein an etch rate of the sacrificial layer and an etch rate of the hard mask layer are selected to substantially completely remove the portion of the sacrificial layer covering the hard mask and the hard mask layer, and wherein the etch rate of the hard mask layer is substantially greater than the silicon layer.